VIA Carbon Offset Programs

Making Sustainable Computing a Reality

CARBON FREE
COMPUTING
Breathe Easier

VIA Technologies, Inc.
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Introduction

Global warming cannot be ignored. Whether referring to the recently released Stern Report (Nicholas Stern who is the head of the UK government's economic service and a former chief World Bank economist)[1] commissioned by the British Government, numerous empirical studies conducted by the world's leading climate, ocean, soil, air, atmospheric, geographic, and environmental specialists, or simply paying attention to the changes in the earth's state of health and climatic conditions, environmental change is clearly a reality.

A world leader in environmental advancements in information and communications technologies, VIA has launched VIA Carbon Free Computing as part of its Clean Computing Initiative, aimed at introducing a range of computing products whereby VIA undertakes to offset the carbon produced by fossil-fueled power stations – in the form of carbon dioxide emissions – in order to operate those products, through a series of forward-thinking projects to protect the environment.

The first product to be introduced was the VIA C7®-D desktop processor, the world's first Carbon Free processor, in 2006. With leading performance per watt in its class and a low maximum design power of just 20 watts at 2.0GHz, the VIA C7-D requires far less electricity to run than competing products, thereby generating dramatically reduced levels of carbon, which are directly offset through a series of programs certified and conducted by third party agencies. The VIA Carbon Offset Programs, and the calculations used to define the offsets, are described herein.

[1] Stern Review on the Economics of Climate Change, HM Treasury: http://www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/stern_review_report.cfm

VIA Carbon Offset Programs

Carbon offset programs comprise a range of projects aimed at preventing or offsetting the carbon produced through power generation to operate the Carbon Free product. Thus, when a VIA C7-D processor is bought, a proportion of the price is invested into one of these projects.

VIA gauges the most environmentally sustainable way to provide either an equivalent source of power that does not contribute to carbon emissions, or a way of sequestering (alleviating) what carbon was produced in the operation of the processor over three years.

VIA Carbon Offset Programs offer three distinct investments:

1) **Renewable Energies** – promoting renewable clean energy such as solar power to circumvent the amount of carbon dioxide ($C0_2$) released into the environment by traditional power plants burning fossil fuels such as oil, coal and gas

2) **Reforestation** – planting trees in different regions to absorb (sequester) the carbon in $C0_2$ emissions, as well as to provide natural habitats

3) **Environmental Conservation** – projects to develop and maintain wetlands and other natural habitats, and conduct ICT recycling programs




VIA has worked with several organizations in this field to ensure that the methodology for calculating offset values measures up to international standards, and with known agencies that supervise and monitor tree plantings and invest in key environmental conservation projects.

1. Renewable Energy

The value of using renewable 'clean' energy sources such as solar and wind power are widely known, and with prices of power conversion equipment coming down, look set to gain greater adoption around the world. By powering whole systems based on power efficient VIA C7-D processors, carbon produced by traditional power stations to run VIA C7-D processors in other parts of the world can be offset by the replacement value of powering complete systems through non-polluting means.

The use of renewable energy raises the key issue of power efficiency of the VIA C7-D processor; that being the performance per watt which exceeds all others in its class. In comparison, the VIA C7-D processor has a maximum design power (TDP) of 20 watts at 2.0GHz, whereas the Intel® Pentium® D is rated at 130 watts at 2.66GHz and the AMD Athlon™ 64 is 89 watts at 2.4GHz. This has a dramatic effect on the carbon produced through the operation of each processor. Hence, the energy consumption of the VIA C7-D is one-tenth that of the Intel Pentium D and half that of the AMD Athlon 64. When combined with design changes in other components like monitors, power supplies and fanless options you change the whole face of computing, making it far more efficient and considerably more sustainable through dramatically reduced carbon emissions.

Operating Efficiency Calculation

When calculating carbon offsets there are many variables which need to be factored into the equation. Among these include: processor power, usage profiles, averaged processor lifetime, and then the proper kilowatt conversion, production measurements, and the correctly sized renewable system to effectively offset the produced carbon.

In general, a processor does not run at peak power all the time. Energy Star, the energy conservation body which tests and certifies products for energy saving operation, states that the average processor spends most of its time in "low usage", "idle state", or "sleep" modes, only operating in "performance" mode for approximately one hour each day. Therefore, to calculate carbon emissions properly we need to perform the following calculation as listed in Table 1 below:

Table 1: Usage Data Used for Load Factor Calculation

	Mode			
	Standby / Off	Idle / Sleep	Low Usage	Performance
Hours per year	2344	280	5886	250
% of time	27%	3%	67%	3%
Watts (est'd by mode)	0	2	10	20
% of max watts	0%	10%	50%	100%
Load factor (%)	0.00%	0.32%	33.6%	2.9%
Total load factor (%)	0% + 0.32% + 33.6% + 2.9% = **36.8%**			

Source: Best Foot Forward

Carbon Dioxide Production Calculation

By applying the above load factor to a product, the amount of carbon produced through its operation may be determined by the following calculation
To determine the actual carbon production requires the final calculations:

Maximum Design Power (TDP)
x Load Factor (36.8%)
x Hours in the day (24)
x Days in the year (365)
x PC average usage (3 years)
/1000 Convert to Kilowatts
x 0.501 to determine carbon production (kilograms)

Table 2: Evaluating Relative Energy Use and Carbon Production

Processor	Mode			
	Standby/Off	Idle/Sleep	Performance	Load Factor
2.0GHz VIA C7-D	0	2W	20W	**9.89%**
2.4GHz AMD Athlon 64	0	26W	75W	**26.92%**
2.66GHz Intel Pentium D	0	5W	34W	**12.06%**

Source: Best Foot Forward

Based upon these calculations the carbon dioxide produced by the three processors over three years is shown in Table 2:

Table 3: Carbon Production by Desktop Processors

Processor	Max Design Power (TDP)	Carbon Produced
2.0GHz VIA C7-D	20	**97kg**
2.4GHz AMD Athlon 64	89	**431kg**
2.66GHz Intel Pentium D	130	**630kg**

When comparing the performance, idle/sleep and off modes of the three desktop processors, a set of assumptions needs to be made in order to evaluate the relative energy use of each processor, and its corresponding carbon emission.

VIA Solar Computing Community Centers

VIA has pioneered the development of community computing solutions powered solely by solar power, including showcase projects in Mali and Samoa.

Through VIA Solar Computing, part of the VIA Clean Computing Initiative, VIA has an ambitious program in place to develop complete computer community centers, which comprise a set up of 3, 6 or 12 VIA certified Carbon Free computer systems, which are exclusively powered by solar/wind power. By giving public access to these facilities, these centers have the additional benefit of directly contending with issues of the global digital divide, by providing ICTs to those who may previously have not had access.

The zero carbon emissions produced by these facilities offsets carbon produced when VIA C7-D processors operate on standard electricity supplies generated by regular carbon producing power grids, such as oil, coal, gas, etc.

The community computing center configuration options of 3/6/12 PCs use the following data to calculate power usage:

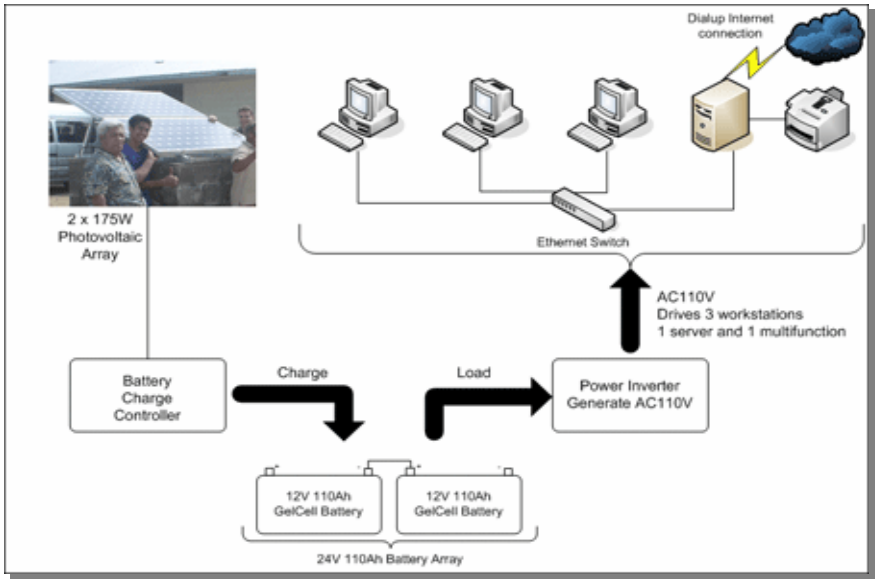
Option A
3 x 50 watt full systems
3 x 65 watt LCD monitors
1 x 25 watt printer
1 x 20 watt set of lighting for community centre
Total: 390 watts

Option B
6 x 50 watt full systems
6 x 65 watt LCD monitors
1 x 25 watt printer
1 x 20 watt set of lighting for community centre
Total: 735 watts

Option C
12 x 50 watt full systems
12 x 65 watt LCD monitors
1 x 25 watt printer
1 x 20 watt set of lighting for community centre
Total: 1425 watts

The VIA Solar Computing Community Centers follow a simple, efficient layout, starting with the energy source (e.g. photovoltaic solar panel), deep cycle batteries and power converters in order to power the PC systems. A typical structure is as shown in Figure 1, with variations based on which option is followed, i.e. how many PCs are installed.

Figure 1: VIA Solar Computing Community Center Structure



Replacement Offset Calculation

The methodology for the community center offset replacement value is based upon the following calculation. Part of this assumes that the lifetime of a photovoltaic solar power system is 20 years, which is based on the average industry warranty for panels.

The sum of: TDP wattage of PC x number of computers Wattage of monitor x number of monitors Wattage of printer x number of printers Wattage of lighting	
x	**Load Factor (36.8%)**
x	**Hours in the day (24)**
x	**Days in the year (365)**
x	**Average photovoltaic solar panel system life (20 years)**
/1000	**Convert to Kilowatts**
x	**0.501 to determine carbon production (kilograms)**

From this, we can obtain the actual carbon offset value of each type of computing community center, both in absolute terms of carbon by weight, and in terms of the

equivalent number of VIA C7-D processors for which the carbon is offset, as shown in Table 4 below:

Table 4: Carbon Offset by a Single VIA Solar Computing Community Center

Configuration	Total Carbon Offset	Equivalent Number of VIA C7-D Processors Offset
Option A: 3 PCs	12,597kg	**1938**
Option B: 6 PCs	23,741kg	**3876**
Option C: 12 PCs	46,029kg	**7752**

When these numbers are calculated into a large scale scenario, such as a government or corporate building, it puts into perspective the true level of pollution produced by typical ICT components. In addition, it allows one to see the potential energy cost savings when choosing to select ultra efficient computing devices over traditional non-efficient devices.

SunMark™: VIA Solar Computing System Rating

VIA has devised a simple measurement to illustrate the number of VIA C7-D processors for which the carbon can be offset through the implementation of a single VIA Solar Computing Community Center. In this diagram showing VIA SunMark™, each sun is the equivalent of 1,000 offset VIA C7-D processors:

Figure 2: VIA SunMark: Measurement of Solar Offset

Active VIA Solar Computing Programs

VIA has worked with governments and international organizations to implement VIA Solar Computing projects in remote parts of the world. Hand-in-hand with the principal objective of the VIA pc-1 Initiative, to enable the next one billion people to gain access to ICTs and so empower them to improve their lives, VIA Solar Computing is helping unconnected communities to tap into the global world of information, entertainment and commerce available on the Internet.

VIA Solar Computing Information Center, Samoa

VIA was enlisted by the federal authorities in the South Pacific to help establish an ICT center in the remote village of Ulutogia, Samoa. Powered by two 175 watt photovoltaic solar panels, the VIA Solar Computing Community Information Centre comprises three complete VIA pc-1 PC systems, with CD-ROM, storage, and 15-inch LCD monitors; additionally, a VIA pc-1 server and combined photocopier, fax, scanner and printer were installed.

Using processors other than the VIA C7-D processor would have required double the number of photovoltaic solar panels to power the center, which in turn would have near doubled the capital cost of the solar power system, as well as increased the cost of shipping and increased the power draw and cost factor of the center were it ever to switch to operating off of the traditional power grid.

Over the average 20-year lifespan of photovoltaic solar panels (typical warranty for photovoltaic panels) the VIA Solar Computing Community Information Centre in the South Pacific will offset the minimum CO_2 production of approximately 1938 VIA C7-D processors.

Figure 3: VIA Solar Computing Community Information Center, Samoa

This VIA Solar Computing Centre in Samoa has been a great success, providing computer training, education facilities and work opportunities for the local communities, and the establishment of e-Education, e-Health and e-Governance programs with government and

United Nations support. Learn more about the Samoa Solar Computing Centre by visiting the VIA website or reading the white papers[2].

Solar Powered Radio Station, Mali

In association with international tech-focused NGO Geekcorps, VIA has helped establish a Solar Powered Radio Station in Bourem Inaly, near Timbuktu, Mali. Many miles from the nearest grid power supply, this station provides communications between the many remote agricultural communities in the area, enabling the rapid dissemination of information over a wide, difficult to access region through simple radio broadcast technology. In an area where power sources are truly hard to access, a small scale solar set-up provides the necessary energy needed to power up the ultra efficient, ruggedised VIA pc-1 system.

Through computing and basic wireless technology, VIA Solar Computing is enabling the local community to access information about health issues, agricultural techniques, local and national news, weather, education and a variety of important information bulletins that would otherwise take days or weeks to spread across this large desert expanse. The station also doubles as the community cinema, projecting a movie onto a plain wall through an inventive projecting device.

This VIA Solar Powered Radio Centre is expected to offset the carbon production of approximately 646 VIA C7-D Carbon Free processors over its effective lifespan.

Figure 4: Solar Powered Radio Station, Bourem Inaly, Mali

[2] Samoa VIA Samoa Solar Computing Centre
http://www.via.com.tw/en/downloads/whitepapers/initiatives/cleancomputing/WP061004SamoaSolarCentre.pdf

2. Reforestation

As the world's first Carbon Free processor the VIA C7-D processor has also accomplished another first as the most efficient desktop processor with leading performance per watt at its maximum design power (TDP) of just 20 watts @2.0GHz. With such efficiency, it not only provides a dramatically reduced power draw it enables us to easily neutralize the small amount of carbon that is produced as a result of its operation.

Through the planting of trees, VIA can sequester the amount of carbon dioxide production that the C7-D processors' use would entail when powered by traditional power sources such as oil, coal or gas.

The VIA Carbon Offset Reforestation Program works by utilizing calculations from third party groups and performing the planting of broad leaf trees (the most effective for carbon dioxide sequestration), usually in the region where the VIA C7-D Carbon Free processors are sold.

For this program, VIA engages the support of third party environment groups to oversee and monitor the planting process. In the UK, the group Carbon Footprint supervises the planting of trees on VIA's behalf; the most recent planting was conducted in County Durham, England, where 100 broad leaf trees were planted. These trees are effective for the sequestration of 25 VIA C7-D Processors over three years and 750 VIA C7-D processors over the course of the average tree's lifetime.

Through our collaboration with reputable third party groups like Carbon Footprint and Best Foot Forward, the regional tree plantings, which take place under their advice and supervision, are then documented and monitored for the course of one year to determine that the plantings successfully take root and perform the much needed function that they were planted for.

When factoring in the lifetime energy consumption, carbon dioxide emissions and equivalent tree growth required to properly sequester the carbon produced the numbers calculate as shown in Table 5:

Table 5: Tree Value Comparison of Desktop Processors

	VIA C7-D	AMD Athlon 64	Intel Pentium D
Power consumption over 3 years (kWh)	52	109	530
Lifetime carbon emissions (kg)	26	54	265
Equivalent years of tree growth per CPU	3.6	7.4	36.2

Source: Best Foot Forward

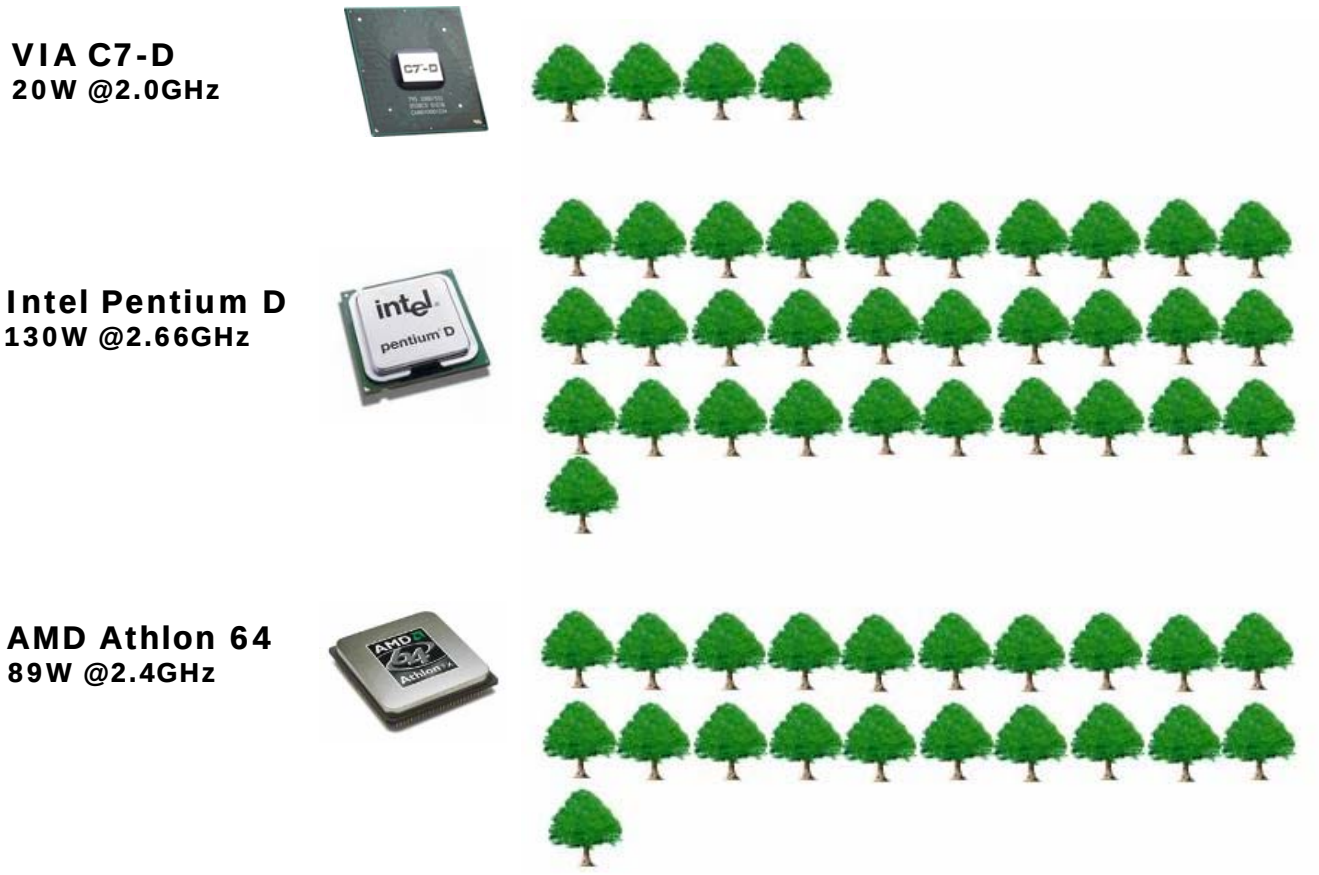
TreeMark™ Processor Rating

To further underscore the importance of the environmental impact of computing, VIA has introduced a new benchmark, TreeMark™, intended as a useful tool for organizations looking to balance environmental impact in their computing purchase decisions.

TreeMark™ looks at the power consumed by a given computing product, calculates the CO2 emissions produced by that product, and then calculates the number of trees it would take to remove that CO2 over the products lifetime. This provides an easy to understand benchmark enabling people to clearly understand the environmental impact of their computing solutions.

Figure 5 demonstrates the power efficiency of competing desktop processors, in terms of the number of trees needed to remove equivalent amounts of CO_2 over three years:

Figure 5: TreeMark Processor Rating



3. Environmental Conservation

In addressing environmental sustainability from a more comprehensive, effective and genuine approach than has been practiced before in the private sector, VIA has included among its carbon offset programs an involvement in environmental conservation projects. Among the conservation efforts include a list of options, which work as isolated donation programs to recognized, reputable groups that work in the fields of:

a) Preservation of wetlands and other necessary ecosystems
b) Addressing the growing problem of appropriate ICT recycling

Based upon the official certification figure set by the environmental organization CarbonNeutral, the cost of offsetting carbon is US$6.00 per metric ton (www.carbonneutral.com), based on the average operating time of 8 hours per day, at 200 days per year for a 3 year period. The donation arising from this calculation goes to organizations charged with the responsibility of preserving wetlands and other natural habitats or to extensive recycling programs for ICT equipment. A third party body governs the transfer and overall supervision of the donation to the organizations in question, thereby certifying the program and its efficacy.

The Advantage of Wetlands

To place this into a broader perspective, while wetlands account for only 4-6% of the earth's land mass, they store approximately 20-25% of the planet's carbon dioxide. Thus, by boosting the protection of wetlands, these programs are effectively enabling the earth to naturally absorb some of the carbon dioxide emitted by fossil-fuel power stations.

Wetland ecosystem preservation and management has many areas, such as conversions to agriculture, forestry, and urban and industrial use, wetland restoration, creations of new flooded land, and peat harvesting. [3] Therefore, there are many opportunities for the placements of the donations.

ICT Recycling

With ICTs accounting for 26% of energy use in office buildings, greater than the power used for all lighting, and office data centers accounting for roughly 50% of the average business power costs, it is clear that ICTs are becoming a substantial enterprise operating cost. In addition, the environmental costs associated with ICT equipment during its manufacturing through to natural resource use and contaminants like lead and mercury; as well as

[3] Wetlands Management, Land Use, Land-Use Change and Forestry, Intergovernmental Panel on Climate Change, UNEP, WMO. http://www.grida.no/climate/ipcc/land_use/196.htm

following its operational life, is a fast growing problem that as yet is not being effectively dealt with.

To place this issue into perspective, there are already on average 130 million new PCs produced per year. This number will grow exponentially as the global digital divide is bridged. In 2002, the billionth PC was manufactured. By 2007, 250 million PCs will be obsolete.[4] Unfortunately, most of these are not expected to be refurbished or recycled.

By directly promoting the growth of effective agencies through targeted investments to contend with this burgeoning issue, VIA is addressing environmental preservation issues at their core, making pragmatic steps towards real sustainability for us, our children, and all that we share this world with.

[4] GreenIT, Sustainable Information Technology presentation

Conclusion: Power Efficiency is Key

VIA's ultra power efficient technology is the key to making sustainable computing a reality.

The efficiency of VIA components not only reduces the consumption of power – and thus, the production of carbon – but does so to such a degree that they enable new and better power source technologies to feasibly and cost-effectively power them. In numerical terms this efficiency can be seen in the comparison graph below:

VIA C7-D processor lowers power consumption by 75%

Table 5: PC Power Comparison

	2.0GHz VIA C7-D based mainboard	based mainboard
Mainboard	13.58W	35.58W
Hard drive & Optical drive	6.58W	6.43W
Total Power Consumption	**20.16W**	**42.01W**

As the leader in multi-sectoral ICT project developments, VIA has assembled a Think Tank of engineering and marketing specialists, and is investing in Research and Development into new computer and energy technologies for the future. Technologies of an ever increasing efficiency, to enable both the bridging of the global digital divide and the provision of clean sustainable energy to people, regardless of location, weather, infrastructure and finances. This is the new face of both computing and development.

VIA Carbon Offset Programs are innovative, flexible and global on a local level. The purpose is to enable computing the world over to be efficient, clean, responsible and technologically progressive. It is also about giving back to the community.

VIA is a company with a human face that is showing first hand that companies and business can indeed be altruistic, universally responsible and economically strong. Through new initiatives, leading power efficient designs and working in collaboration with environmental groups and causes VIA is leading the way to sustainable computing. Computing that enables a future.

The VIA Clean Computing Chronology

VIA Processors use less electricity

Lowers carbon emission generated from power plants

Any emissions generated are offset through regionally beneficial projects

Cleaner air

Healthier environment

A better way to work and live

Appendix: References

- Tree Planting Certificate
http://www.via.com.tw/en/downloads/whitepapers/initiatives/cleancomputing/Tree-certificate.pdf

- Carbon Footprint Cover Letter for Tree Sales
http://www.via.com.tw/en/downloads/whitepapers/initiatives/cleancomputing/Coverletter-treesales.pdf

- The Carbon Footprint of Computing – Author: Best Foot Forward
http://www.via.com.tw/en/downloads/whitepapers/initiatives/cleancomputing/TreeMarkMethodology.pdf

- Green IT for Green Buildings, Sustainable Information Technology
http://www.greenit.net/